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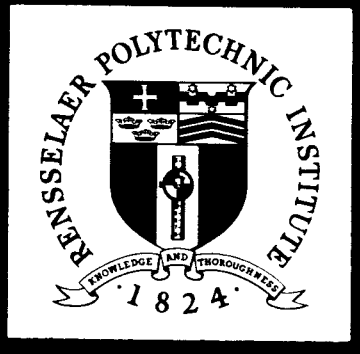

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STUDY OF ELECTROMAGNETIC WAVE POLARIZATION IN MAGNETO-PLASMAS BY A MATRIX METHOD OF CRYSTAL OPTICS

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TECHNICAL REPORT No. 3, June, 1961

This work was partially supported by the National Aeronautics and Space Administration under Research Grant No, NsG 48-60

STUDY OF ELECTROMAGNETIC WAVE POLARIZATION IN MAGNETO-PLASMAS BY A MATRIX METHOD OF CRYSTAL OPTICS.

In a series of papers Jones[1] has developed a method for treating the behavior of optical systems. We propose here a method of treating the study of electromagnetic wave propagation through magneto-plasmas by applying a modification of his method which is appropriate to the microwave region of the spectrum.

The method of Jones is based upon the assumption that the components of the electric field vector of the light wave leaving the system are linear functions of the electric field components of the wave entering the system. That is, if E_1 and E_2 are the complex components of a wave entering the system, then the output components of the wave, E_1' and E_2', are given by

$$\begin{bmatrix} E_1' \\ E_2' \end{bmatrix} = \begin{bmatrix} m_{11} & m_{12} \\ m_{21} & m_{22} \end{bmatrix} \begin{bmatrix} E_1 \\ E_2 \end{bmatrix}$$

or

$$E' = M\,E$$

where M is a matrix characterizing the system.

Systems which act to alter the relationship between orthogonal components of an electromagnetic wave in the microwave region might usefully be characterized by such a matrix. A plasma in the presence of a dc magnetic field might be considered as such a system.

A method for measuring the matrix has been proposed (Vol. 37 of reference 1) for application in the optical regions. The ease with which the components of the electric field can be separated in a microwave circuit makes the measurement of the matrix M simpler at microwave frequencies

By factoring out m_{22} three polarization measurements using a microwave polarimeter[2] will determine the matrix M to within the complex constant m_{22}. These measurements consist of measuring the output polarization for three differently oriented linearly polarized input signals. A block diagram of the microwave circuit is shown in Figure 1. The complex constant m_{22} can be determined from a conventional attenuation and phase shift measurement. This is done by orienting the rectangular guide of the receiving horn such that only the E_2' component is received when the input signal to the system is linearly polarized in the X_2 direction. In this way the matrix M can be uniquely determined.

This work was partially supported by NASA under research contract no. NsG 48-60

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1. R.C. Jones, "A New Calculus for the Treatment of Optical Systems," J. Opt. Soc. of Am., Vol 31, pp. 488-503; 1941 Vol. 32, pp. 486-493; 1942; Vol. 37, pp. 107-112; 1947; Vol. 38, pp. 671-684; 1948; Vol 46, pp. 126-131; 1956

2. P.J. Allen and R.D. Tompkins, "An Instantaneous Microwave Polarimeter," Proc. IRE, Vol. 47, pp. .23.-.237; July 1959

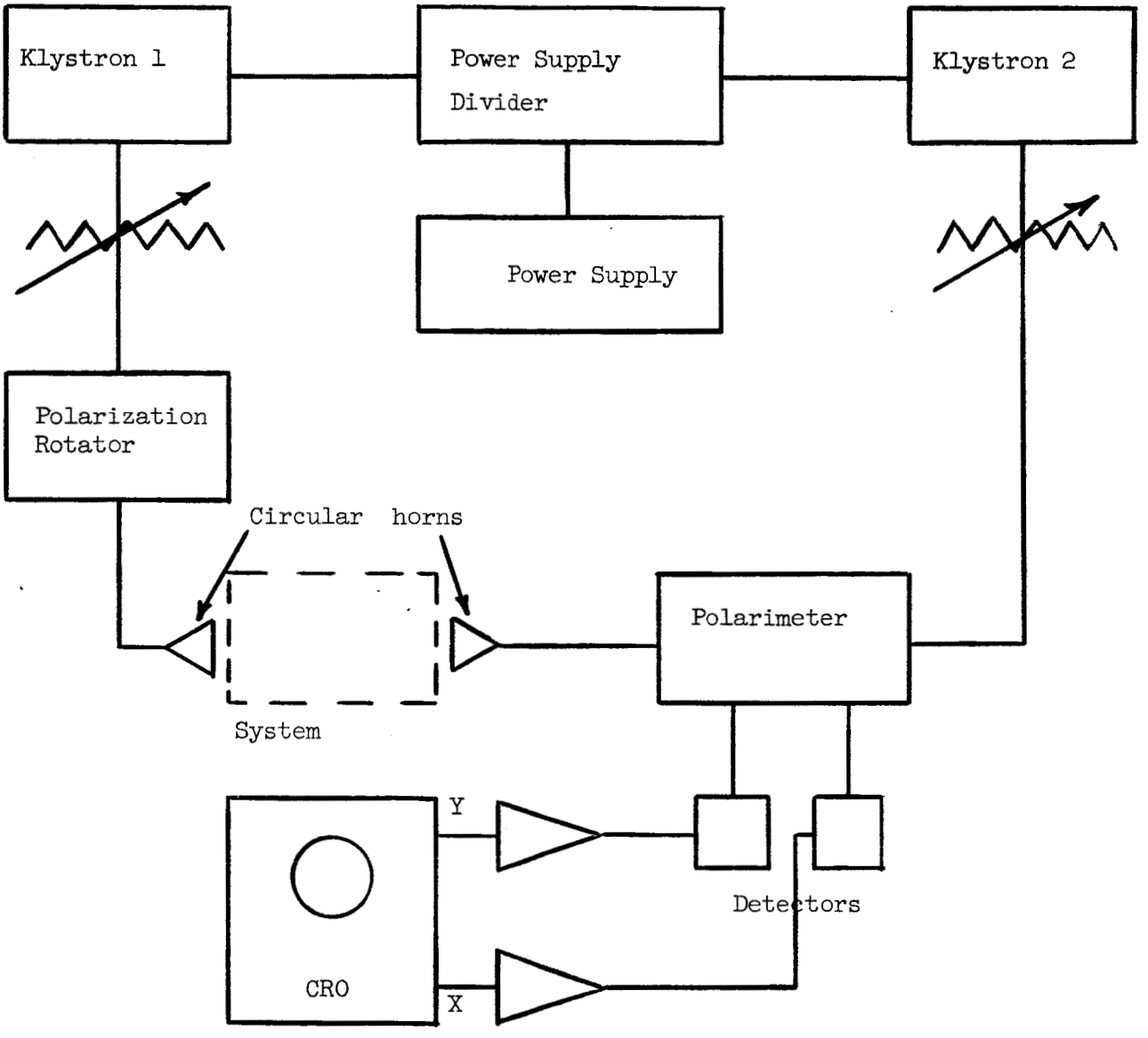

Figure 1. Polarimeter Microwave Circuit